

Decomposition of the β phase in alloys...

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6Al alloy and lowers that of Ti with 7% Al. Quenching of Ti with 7% Cr from 1,000° nearly doubles the hardness obtaining after tempering (HV=478 vs. 250), but its notch toughness is very low (0.3 kgm/cm²). Aging of Ti with 7% Cr at 450° does not affect its hardness during the first 15 min, but subsequently reduces it appreciably. The results of X-ray metallography after various heat treatments are tabulated. After water quenching from 1,000° Ti alloys with 7% (Cr+Al), a metastable ω phase was fixed jointly with the β phase in only two cases, namely, with 0 and 0.87% Al. In the other alloys investigated under quenching a metastable α' phase was formed. 15-min aging of quenched Ti-Cr-Al at 450°C led to a sharp increase (450 or more) H_V without altering its phase composition qualitatively. It follows that the hardening attainable by tempering of Ti-7(Cr+Al) alloys containing 1.7% and more Al is attributable, apparently, to an incipient stage of decomposition of the metastable α' phase which cannot be fixed by X-ray metallography. Following quenching a Ti-7Cr alloy consists of large grains of pure β phase, whereas ternary alloys containing less than 6% Cr manifest an acicular α' -phase structure, and the Ti-6Cr-1Al alloy contains conjointly grains of β phase, ω phase, and regions of large acicular α' phase. The coexistence of ω and α' phases in a ternary alloy of the Ti-Cr-Al system is of especial interest, since in binary alloys of Ti with transition metals the appearance of an α phase, as a rule, coincides with the disappearance of the ω phase. There are 3 figures, 3 tables, and the 1 English-language reference cited above.

ASSOCIATION: None given.

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AUTHORS: Blok, N.I., Glazova, A.I., Lashko, N.E., Solonina, O.P.

TITLE: Phase composition of the BT3-1 (VT3-1) titanium alloy as a function of the aluminum, chromium, molybdenum, and iron content and of its heat treatment.

SOURCE: Titan v promyshlennosti; sbornik statey. Ed. by S.G. Glazunov. Moscow, 1961, 112-120.

TEXT: This is a report of an experimental investigation occasioned by a recent decrease in the strength of several Ti alloys, including the BT3-1 (VT3-1), as a result of the introduction of higher-quality sponge Ti. The investigation studied the effect of the basic alloying elements Al, Cr, and Mo on the phase composition and the properties of the resulting alloy. The additional consideration of Fe addition was intended primarily to explore the consequence of its introduction as an unavoidable part of cheaper alloying charges. Heat-treatment methods designed to attain maximum strength and adequate ductility (to replace currently used isothermal anneal) were also explored. It was found that: (1) All of the alloying elements of the VT3-1 alloy stimulate the formation therein of a residual or retained β phase; Cr and Mo enter directly into the β phase; with an increase of their content in the

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alloy the amount of β phase and the concentration of these elements in it increases; Mo appears to be a more powerful β -phase stabilizer than Cr; (b) Al enters the β phase solely as an addition and affects the increase of the amount of that phase only indirectly by reducing the solubility of Cr and Mo in the α -Ti solid solution.

(2) With increasing Al and Mo content in the VT3-1 alloy the stability of the β phase is enhanced after prolonged aging at 450°C. (3) Isothermal heat treatment leads to the formation of a relatively small amount of β phase; this explains its impaired strength as compared with that of alloys subjected to a two-stage heat treatment consisting of a quenching and a tempering operation (details tabulated). (4) The difference in the mechanical properties of the two specimen rods of one and the same melt (brittle rupture of one, failure with distinctly plastic deformation of the other) can be explained by the state of the α phase, primarily its form and distribution, and also the size of the primary β -phase particles. There are 2 figures and 4 tables; no references.

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S/762/61/000/000/011/029

AUTHORS: Vinogradova, Ye.A., Kokhova, G.M., Lashko, N.F.

TITLE: Phase analysis of heat-treated BT3 (VT3) and BT3-1 (VT3-1) alloys.

SOURCE: Titan v promyshlennosti; sbornik statey. Ed. by S. G. Glazunov.
Moscow, 1961, 121-130.

TEXT: The paper comprises a status report on an experimental investigation of the phase composition of the VT3 and VT3-1 alloys of the Ti-Al-Cr-Mo system and the effects thereon of heat treatment. Some of the source data are drawn from Blok, N.I., et al., Zavodskaya laboratoriya, no. 2, 1958, 141, and pp. 112-120 of the present compendium (Abstract S/762/61/000/000/010/029). At working temperatures the VT3 alloy is found to be two-phase, with an α - (or α' -) phase matrix. During cooling of the alloy from high temperatures (HT), the HT β phase may undergo one of three transformations: (1) During fast cooling the β phase transforms into the metastable phase α' ; (2) during fairly slow cooling the β phase transforms into the metastable α' phase and some residual β phase; (3) very slow cooling leads to the eutectoid decomposition $\beta \rightarrow \alpha + \text{TiCr}_2$. A residual β phase, enriched with Cr, will also form, both during very slow cooling and in the process of aging. In the latter, the alloying elements are redistributed between the α and the β phase.

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An increase in the aging temperature of VT3 and VT3-1 alloys to 500-550°C enhances the enrichment of the residual β phase with alloying elements. The hardness (H) and ductility (D) characteristics of these alloys can be greatly varied by increases in the aging T after single quenching. The changes in H and D and in the lattice parameters are graphed against T (at 50°C intervals, up to 700-800°C). Greatest H and smallest D is obtained upon quenching and subsequent aging at 450-550°C. This is attributed to decomposition of the α' phase, separation of a dispersive α phase, and - to some extent - the state of the β phase. Thus, the properties of the two alloys after heat treatment are governed by the state, distribution, and form of the particles of α , α' , β , and TiCr_2 and the redistribution of the alloying elements, and not by the formation of a metastable ω phase erroneously postulated by others. The tests comprised melts with differing contents of alloying elements, prepared in vacuum arc furnaces with consumable electrodes, in which Ti-1 (TG-1) Ti and a 50:50 Al-Cr ligature and a 60:20:15 Al-Cr-Mo ligature are fused. The chemical melt composition is tabulated. Phase analysis after 850°C quench ($\alpha+\beta$ -phase region) and 980-990°C quench (β -phase region) and 400-700°C aging was performed by the powder method (3 full-page tabulations and graph). The total β -phase content did not exceed 8.5% by weight, while the α (or α') content did not go below 90%. A total β -phase quench was not achieved. The hydrogen content, which could possibly have been responsible for brittleness, was within the bounds specified

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by the Technical Specs. No Ti hydride was found. The geometric characteristics of the various phases, including the laminar nature of the β phase, the acicular form of the α' phase, the appearance of an overall basketlike structure, and the segregation of α phase as a continuous edging at the grain boundaries are described in detail. Desirable avenues for future research are outlined. There are 4 tables and 3 figures; 2 Russian-language Soviet references are cited at the beginning of the text.

ASSOCIATION: None given.

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AUTHORS: Blok, N.I., Glazova, A.I., Yakimova, A.M., Lashko, N.F.

TITLE: Investigation of the β phase of the two-phase alloys BT3-1 (VT3-1) and BT8 (VT8).

SOURCE: Titan v promyshlennosti; sbornik statey. Ed. by S. G. Glazunov. Moscow, 1961, 135-141.

TEXT: The paper describes an experimental investigation of the mechanism of H embrittlement of two-phase Ti alloys in which residual β -phase decomposition with separation of chemical compounds does not occur. Whereas in the Ti-Al-Cr alloy BT3 (VT3) the residual β phase decomposes and segregates TiCr_2 and TiH , and thus becomes embrittled, the Ti-Al-Cr-Mo alloy VT3-1 and the Ti-Al-Mo alloy VT8 do not incur such process. X-ray metallography of anode precipitates of these alloys reveals the existence of a β phase alone, in which the elementary-lattice parameter increases with increasing H content in the alloy. The particular objective of the present test is the investigation of the enrichment of the β phase with heavier elements, such as Cr and Mo, the atomic radii of which are smaller than the atomic radius of Ti, during 100-hr aging at 450-500°C. The method employed comprises the electrolytical phase separation (Blok, N.I., et al.,

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Zavodskaya laboratoriya, no.1, 1956) and X-ray metallography. The electrolytical phase separation was performed by an improved method of anodic dissolution of metals in a waterless electrolyte (2-3 g KSCN, 10 g citric acid, 100 ml glycerol, and 1,200 ml methanol), a current density of 0.01 a/cm^2 , a terminal voltage of 30 v, and a bath temperature of -7 to -10°C . Maximum time 45 min. Introduction and withdrawal of the cylindrical specimen was performed under current; the specimen was then washed twice in methanol at -7° and was air-dried. The anodic precipitate was scraped off the specimen and preserved at sub- 0°C temperature. The Ti, Cr, and Mo contents in the β phase were determined by the usual methods. The H content therein was determined in the universal equipment of A.M. Yakimova (In Trudy komissii po analiticheskoy khimii, "Analiz gazov v metalle," Akad.n.SSSR, v.X, 1960) according to the method described by Yakimova in her paper on pp.131-134 of the present compendium (Abstract S/762/61/000/000/012/029); chemical analysis is possible only when a single phase is present. Test results are summarized in a full-page table and are graphed. Results: (1) The Cr and Mo content in the β phase of VT3-1 and the Mo content in the β phase of VT8 are considerably greater than their mean content in the alloys. The Al content in the β phases is lower than its mean content in either alloy. For example, the β phase of VT3-1 alloy contains 9.24% Cr, 10.44% Mo, and 2.05% Al, as against 1.93% Cr, 1.5% Mo, and 4.6% Al mean content in the alloy. The β phase of the VT8 alloy contains 25.38% Mo and

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2.44% Al, as against 3.45% Mo and 6.33% Al mean content. (2) Aging of VT3-1 and VT8 alloys entails β -phase enrichment with alloying elements; this is an indication of the occurrence of transformations toward phase equilibrium. (3) The H content of the β phase depends on its total content in the alloy and on the alloying-element enrichment in the β phase. (4) The residual β -phase content of VT3-1 and VT8 alloys increases with increasing H content therein. There are 2 figures, 3 tables, and 4 Russian-language Soviet references cited in the text. The participation of Ye.A. Vinogradova and Ye.I. Zvontsova in the experimental work is acknowledged.

ASSOCIATION: None given.

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AUTHORS: Blok, N.I., Glazova, A.I., Kurayeva, V.P., Lashko, N.F.

TITLE: Phase analysis of the BT10 (VT10) titanium alloy.

SOURCE: Titan v promyshlennosti; sbornik statey. Ed. by S. G. Glazunov. Moscow, 1961, 227-231.

TEXT: This paper describes an experimental X-ray and chemical analysis of electrolytically precipitated VT10 alloy (after 1-hr 800°C anneal in vacuum), performed by a method described in Zavodskaya laboratoriya, no. 2, 1958, 141. The investigation was motivated by a desire to determine whether the age hardening of this creep-resistant Ti-Al-Cu-Sn alloy is produced by the separation of some intermetallic-compound phase, since this alloy, like the two-phase Ti-Cu alloys, has no residual β phase that could be fixed by quenching. Reference is made to the phase diagram of A. Joukainen, et al. (J. Metals, v. 4, no. 7, 1952, 766), according to which Ti_2O is the intermetallic phase richest in Ti. The present investigation identified an intermetallic phase of variable composition with a tetragonal face-centered crystal lattice of the Ti_3Cu type, namely $(Ti, Al, Sn)_3Cu$. The phase compositions of VT10 alloy with slightly variable Cu and Al contents and after cooling at various rates, as obtained by the X-ray and the chemical method, are tabulated. All findings support the conclusion that the (Ti, Al, Sn)-to-Cu ratio is extremely close to 3. The Ti_3Cu -type phase thus identified is a solid solution in which some nodes of the

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crystalline lattice, ordinarily occupied by Ti, are occupied by Al and Sn atoms. An increase in Cu content from 2 to 3% increases the quantity of $(Ti, Al, Sn)_3Cu$ continuously from 5.75 to 8.35%. No comparable change occurs upon increase of the Al content from 5 to 6%. It is concluded that the VT10 alloy gives rise to highly dispersive products of a eutectoid reaction $\beta \rightarrow \alpha + (Ti, Al, Sn)_3Cu$. X-ray analysis indicates that the fundamental phase in VT10 is an α phase, both primary and transformational (α'). No residual β phase can be found in the alloy. It is known that in Ti-Cu alloys the eutectoid decomposition upon cooling from elevated T occurs very rapidly. It proceeds even more speedily in alloys of the Ti-Al-Cu-Sn system, and the β phase decomposes in toto into an α phase and an intermetallic compound. The effects of the temperature levels and rates of cooling on the phase composition are tabulated in detail. The structural changes in the VT10 alloys apparently are determined by three factors: (1) Change in the size of the primary grains; (2) change in the shape of the particles of transformed β phase (α' phase); and (3) change in the shape of the particles of the intermetallic phase $(TiAlSn)_3Cu$ and the character of its distribution. There are 1 figure, 5 tables, and 4 references (1 Russian-language Soviet, 2 English-language, and 1 German). The participation of Zh.D. Afanas'yeva, Ye.A. Vinogradova, Ye.I. Zvontsova, and L.V. Polyakova in the experimental portion of the investigation is acknowledged.

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AUTHORS: Lashko, N. F., Lashko-Avakyan, S. V., Candidates of Technical Sciences

TITLE: On the Selection of Brazing Temperature

PERIODICAL: Svarochnoye proizvodstvo, 1961, No. 3, pp. 11-14

TEXT: There was until the present no founded theoretical basis for selecting the proper brazing temperature assuring high quality of the brazed joints. The authors investigate temperature conditions of capillary brazing, and reject the method based merely on the knowledge of the properties of the solder, as not sufficiently accurate. Depending on the nature of the contacting liquid solder and the alloy to be brazed, the temperature and duration of the contact, the brazed metal undergoes a more or less intensive diffusion in the solder (erosion). The properties of joints produced by capillary brazing are determined by the nature of the physico-chemical interaction of the liquid solder and the brazed metal, the temperature and duration of the interaction and by the capacity of the liquid phase of filling the capillary interspaces. The minimum brazing temperature must assure the filling of capillary interspaces and a satisfactory adhesion of the solder with the base metal. It must be equal to or above the temperature

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of transition into the liquid-solid phase of the alloy formed in the gap, since the flowing of the solder into the gap can be assured only at this temperature. From this point of view, the brazing temperature must be selected according to the liquid-solid temperature range of the alloy formed in the capillary (Fig. 2). In practice, however, the necessity arises to conduct the process at elevated temperatures and for an extended period of time, as e. g. in stepped and furnace brazing; when combining brazing and heat treatment of the joint; in gas flux brazing etc. On the basis of data obtained with specimens shown in Figure 2, the spreading of the solder and its interaction with the base metal at elevated temperatures can to a first approximation be divided into the following three stages: 1) weak interaction of the liquid solder with the base metal and frontal motion of the solder over the surface; 2) intensified interaction and ramified motion; 3) intensified interaction and frontal motion. These 3 stages are illustrated in Figure 3. They were observed in furnace brazing in a vacuum of some austenitic bi-phase steels with solders on Ni-Mn-Cr and Ni-Si-P-Cr base (Fig. 4). When using solders that form eutectics with the base metal, the intensified diffusion of the base metal is promoted 1) by a great difference between the melting temperature of the brazed metal and eutectics, since the contact of the metal and the liquid phase is prolonged; 2) high solubility of the base metal

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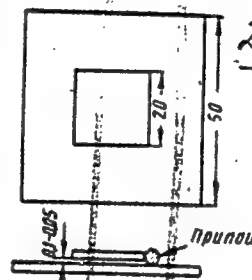
in the liquid solder; 3) high content of the brazed alloy base in the eutectics. The joint effect of these factors on erosion of the brazed metal can be observed when brazing aluminum with lead, zinc and nickel with Ni-B and Ni-P base solders (Table 2). The formation of eutectics in the soldered joint is preceded by a diffusion process between the solder and the braze alloy. Therefore the presence of an element in the alloy forming eutectics with the solder, accelerates the formation of a liquid phase and consequently, promotes intensified erosion of the base metal. Spreading of the solder over the brazed metal is reduced when the solubility of the base metal in the solder is raised. The maximum temperature of brazing is found to be that temperature, above which erosion of the brazed joint and processes of reactive diffusion of the I and II order take place, strongly degrading the quality of the joint. The time-temperature dependence shown in graph 6, should be used as a basis when selecting time and temperature conditions for brazing.

Figure 2:

Figure 2:

Schematic drawing of a specimen for determining the flowing of solder into the capillary gap (0.05 - 0.1 mm) between 60 x 60 and 30 x 30 mm plates

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Figure 3:

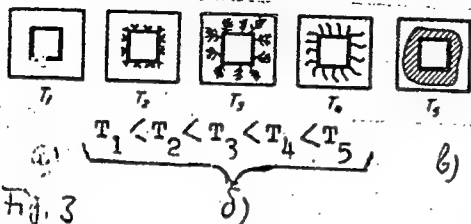
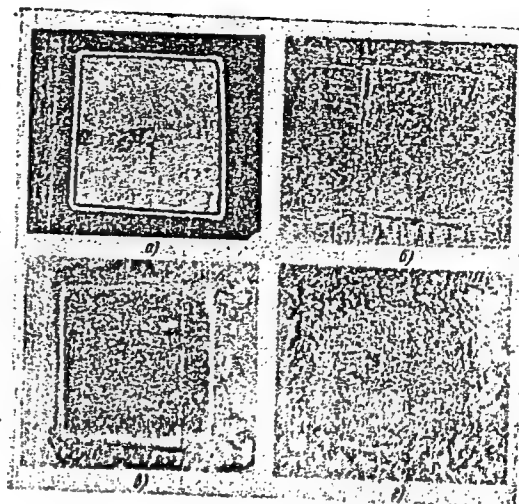


Figure 3:

Schematic representation of three stages of spreading and interaction of the solder with the material to be brazed in the active area
a - weak interaction of the liquid solder with the base material; frontal motion over the surface; b) intensified interaction and ramified motion c) intensified interaction and frontal motion

Figure 4:



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Figure 4:

General view of specimens showing the flowing of the solder into the gap after vacuum brazing (10^{-2} mm Hg) at different temperatures a) $1,180^{\circ}\text{C}$; b) $1,220^{\circ}\text{C}$; c) $1,250^{\circ}\text{C}$; d) $1,280^{\circ}\text{C}$. Base metal: stainless bi-phase steel; Ni-Cr-Si-P base solder.

Table 2:

Metal to be brazed	Solder	Temperature in $^{\circ}\text{C}$		Maximum diffusion of the base metal in the solder	Content of base metal in eutectics	Intensity of erosion
		$T_m - T_e$	$T_n - T_e$			
Al	Zn	280	39	1	5	Medium
Al	Sn	431	3	0	0.5	None
Al	Al-Si (eutectic)	83	0	1.65	88.3	"
Ni	Ni-B (eutectic)	312	0	0	96	Strong
Ni	Ni-P (eutectic)	572	0	0	89	"

*) T_m , T_n , T_e - melting temperature of the metal to be brazed, solder, eutectics, respectively.

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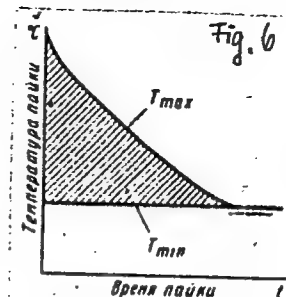
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Figure 6:

Dependence of the temperature range of brazing on the brazing time Area of conditions assuring high quality joints is crosshatched. There are 3 tables, 6 figures and 6 references: 1 Soviet, 2 English, 2 German and 1 French.



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AUTHORS: Lashko, N. F., Lashko-Avakyan, S. V., Candidates of Technical Sciences

TITLE: The Scientifico-Technical Conference on the Brazing of Metals

PERIODICAL: Svarochnoye proizvodstvo, 1961, No. 4, pp. 41 - 42

TEXT: The scientifico-technical Conference on the brazing of metals was convened in Moscow from December 15 - 16, 1960 by the welding department of TsP NTO MASHPROM. The opening report was delivered by Professor A. A. Alov, Doctor of Technical Sciences. The conference then heard the following reports: S. N. Lotsmanov, Candidate of Technical Sciences on the present state and problems of brazing; N. F. Lashko and S. V. Lashko-Avakyan, Candidates of Technical Sciences on "The Theory of Selecting Temperature Conditions of Capillary Brazing"; V. P. Frolov, Candidate of Technical Sciences, on "Considering Temperature Factors and Their Correlation when Planning Soldered Joints and Evaluating the Degree of Softening of Aluminum Alloys During Brazing"; A. I. Gubin, N. F. Lashko, S. V. Lashko-Avakyan, Candidates of Technical Sciences and Engineer V. V. Griova on the use and development of self-fluxing solders for brazing composite stainless steel

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The Scientifico-Technical Conference on the Brazing of Metals

articles; I. I. Il'yevskiy and N. N. Sirchenko, engineers on the effect of liquid solders on the proneness to brittle failure of stainless steels; V. A. Yekatova, engineer, and A. S. Medvedev, Candidate of Technical Sciences, on brazing with low-melting solders; V. A. Yermolov, engineer, on the technology of brazing with high-temperature solders used for soldering steels and bronzes; I. K. Sklyarov, engineer on brazing titanium and its alloys; A. V. Shavkunov, engineer, on the research of new active gas fluxes and on the use of ammonium fluoride as an active gaseous medium; I. I. Yanovskiy, V. A. Morozov and V. N. Artsimovich, engineers, on the development of new brazing methods for hard-alloy mining instruments; G. S. Keylin, engineer, on the development of new brazing methods for medical instruments; Ya.M. Kanevskiy, Candidate of Technical Sciences, on new methods of abrasive fluxless brazing of aluminum and its alloys with low-melting solders. The Conference decided the organization of a special institute of brazing and of yearly meetings.

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AUTHORS: Lashko-Avakyan, S. V., Lashko, N. E., Candidates of Technical Sciences

TITLE: Corrosion resistance of aluminum alloy joints brazed with low melting solders

PERIODICAL: Svarochnoye proizvodstvo, no. 5, 1961, 13 - 16

TEXT: Problems on the corrosion resistance of joints of aluminum and its alloys brazed with low-melting solders, were until the present not sufficiently studied. When analyzing corrosion processes it is important to establish anodic and cathodic areas in the soldered joint. For this purpose some experiments were made with AMu (AMts) alloys which were brazed with stannous solders alloyed with zinc, lead, antimony and cadmium. Electrode potentials were determined on the Raps potentiometer by A. T. Shibadeyeva. The composition of the solders investigated are given in table 1. An electrolyte of 0.01N NaCl solution was employed. The results obtained show that tin alloys with lead, copper, cadmium and antimony have more positive potentials than the AMts alloys and represent the cathode in the "solder-AMts alloy" pair. Tin alloys and alloys of lead with tin, containing 10% and more zinc, and zinc alloys with aluminum show more negative

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electrode potentials than the AMts alloy and are the anodes in the "solder-AMts alloy" pair. Analyses of various cases of corrosion failure of aluminum alloy joints brazed with low-melting solders show that the substantial effect is exerted by processes of crevice corrosion (Ref. 1 - 6). Intensive development of crevice corrosion in structures takes place as a result of inhibited diffusion exchange of elements in electrolytes surrounding the structure, in its crevices and gaps. This is due to the presence of peculiar interrupted "bridges" developed during brazing. (Fig. 2) The peculiarities of crevice corrosion in aluminum alloys were investigated on AMts alloys brazed with Sn - Zn solders, and tested in 3% NaCl + 0.1% H₂O₂. Proneness to crevice corrosion was observed in AMts alloys brazed with solders which are not noticeable soluble in aluminum, i. e., the solder systems: Sn-Pb; Sn-Cd; Sn-Al; Cd-Zn, (at relatively low Zn content) and Sn-Sb. The low mutual solubility of these alloys with the AMts alloy and the low soldering temperature do not promote the formation of a strong and tight joint. Gaps between the base metal and the solder in the joint and the joint-adjacent zone are the source of crevice corrosion. In joints brazed with solders containing considerable amounts of zinc (Sn-Zn; Sn-Zn-Al; Zn-Al systems) where strong and tight joints between the solder and the brazed metal are produced, crevice corrosion was not revealed. This proves that crevice corrosion depends mainly on the zinc content in the low melting solders. Corrosion

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tests were conducted by V. A. Klimova. Great losses of strength as a result of corrosion were revealed in specimens soldered with П 150А (P150A) solder, (containing 38.5% Sn, 57.7% Cu and 3.8% Zn), П 170А (P170A) (75% Sn, 20% Cd and 1% Ag) and П 200А (P200A) (90% Sn, 10% Zn). In specimens brazed with П 250А (P250A) solder (80% Sn, 20% Zn) and protected by varnish coatings, strength losses were not observed. Specimens brazed with П 300А (P300A) (60% Zn, 40% Cu) solder did not change in strength after 4 months tests in tropic atmosphere chambers and during 9-months open air tests. Greatest corrosion resistance was shown by specimens brazed with zinc base solders, increasing with a higher Zn content, which also improved their bond with the brazed Al alloys. A higher Zn content raises however the melting temperature of stannous solders and their crystallization and hot brittleness range which makes abrasive and ultrasonic brazing most difficult. The liquid-solid range can be reduced by adding to the alloys with 35 - 39% Zn small cadmium and bismuth admixtures (about 0.2% each), to prevent hot brittleness and make them fluid at 250 - 260°C. S. V., Lashko-Avakyan, N. F. Lashko and B. V. Nikolayev suggested corrosion resistant tin-base alloy 250 (VP250A) of the following composition: 35 - 39% Zn; 0.4% Cu; 0.2 - 0.3% Cd; 0.2 - 0.3% Sb. Abrasive brazing with this solder can be made at 210 - 260°C, ultrasonic brazing at 250 - 260°C. High corrosion resistance is offered by joints

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brazed with Zn-Al base solders and aluminum alloys brazed with some zinc-base solders: ΠC_p 5AKTc (PSr5AKTs) (5% Ag, 2% Al, up to 0.15% Si) and ΠAKT_c (PAKTs) (20% Al; 0.15% Si) with flux removal after brazing. Crevice corrosion revealed in AMts alloy specimens brazed with PAKTs solder was due to frontal galvanic corrosion of the soldered joint. There are 6 tables, 2 figures and 8 references: 5 Soviet and 3 non-Soviet.

Table 1:

No. of solder	Composition of tin base solders in %						
	Pb	Sb	Cd	Zn	Cu	Al	Sn
1	20	-	-	-	-	-	80
2	-	-	-	10	-	-	90
3	-	-	10	-	-	-	10
4	-	-	-	-	5	-	95
5	-	6	-	-	-	-	94
6	20	-	10	-	-	-	70
7	-	-	10	10	-	-	80

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Table 1 continued:

10	-	6	-	20	-	-	74
11	-	6	10	20	-	-	64
13	15	-	7	-	-	-	74
15	51	-	9	9	-	-	31
29	-	-	-	95	-	5	-
30	-	-	-	97.5	-	2.5	-
31	-	-	-	40	-	60	-
32	-	-	-	100	-	-	-
33	-	-	-	-	-	-	100

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22016

1.2300 also 1454, 1413, 1573

S/135/61/000/006/008/008
A006/A106

AUTHORS: Lashko, N.F., Lashko-Avakyan, S.V., Candidates of Technical Sciences

TITLE: On the problem of "hot" and crystallization cracks in welding and casting

PERIODICAL: Svarochnoye proizvodstvo, no.6, 1961, 41 - 42

TEXT: The authors discuss an article published by A.A. Bochvar, N.N. Rykalin, N.N. Prokhorov, I.I. Novikov and B.A. Movchan in the 1960 October copies of "Svarochnoye proizvodstvo" and "Liteynoye proizvodstvo", on "hot" cracks, which are identified with crystallization cracks forming during casting and welding of alloys. The authors of the present article state that the formation of hot cracks in casting and welding has not been sufficiently treated so that the purpose of the article was not fulfilled. A number of debatable points are discussed and the following concepts on the subject are presented: 1. Crystallization cracks in casting and welding are one of the varieties of "hot" cracks; they arise, as a rule, in the non-equilibrium crystallization range of alloys and may develop in solid state during cooling. Crystallization cracks include: a) those forming in the solidified portion of the alloy where the liquid phase is drawn-in

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22016

On the problem of "hot" and crystallization cracks...

S/135/61/000/006/008/008
A006/A106

X

from the non-solid portion under the effect of capillary and hydrostatic forces, and b) cracks, forming after non-equilibrium solidifying of the alloy as a result of its partial fusion during heat redistribution of alloying elements by cooling. 2) Crystallization cracks may arise as a result of low macroductility of the alloy in both the liquid-solid and the solid-liquid ranges (in the "effective" crystallization range). 3) Solid crystals show considerable ductility in the crystallization range. The low macro-ductility of a liquid-solid material during its expansion in the solid-liquid range is connected with the local nature of deformation of its solid portion. The authors reject the theory that alloys in the crystallization range possess least macro-ductility, as a characteristic constant of each alloy. 4) The low ductility range (brittleness) includes not only the "effective" crystallization range. "High ductility" of alloys observed in the borders of the solid liquid and the liquid-solid state, is actually related to the stabilization of the alloy state after solidifying and redistribution of its solid portion. When determining true macro-ductility of alloys in the crystallization range phenomena connected with the shifting of the liquid phase should be prevented, in particular, after failure of specimens. 5) The brittleness range of some alloys during solidification may be below the real solidus temperature. Cracks forming in this range are considered as "hot" sub-solidus cracks. 6) Cry-

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On the problem of "hot" and crystallization cracks... S/135/61/000/006/008/008
A006/A106

stallization cracks may also arise during heating of the alloy as a result of its partial fusion. The limitation of conditions promoting hot crack formation merely by cooling the liquid alloy, excludes crystallization cracking in weld-adjacent areas during multi-layer and resistance welding. 7) The possibility of crystallization crack formation in the weld-adjacent zone during welding, the mixing of seam and base metal and the specific thermal effect of the base metal, create a substantial difference in the conditions of crystallization cracking during casting and welding. 8) The determination of an "effective" crystallization range from a phase diagram should be avoided, since the temperature range of the solid-liquid state of natural alloys may vary due to impurities or non-equilibrium crystallization. 9) The authors approve the statement that the evaluation of proneness to crystallization cracking may be erroneous if determined from the temperature range of brittleness, ductility in this range, or the rate of increasing elastic-plastic deformation at dropping temperatures. 10) The length and width of cracks arising during casting and welding is the simplest measure of the resistance to the formation and development of crystallization cracks. Effective methods should be used to distinguish the proneness of an alloy to crystallization cracks and its proneness to the development of cracks in solid state. The proposed quantitative determination of crystalliza-

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On the problem of "hot" and crystallization cracks ... S/135/61/000/006/008/008
A006/A106

tion crack-resistance from the difference between least relative elongation in the "effective" crystallization range and the magnitude of free temperature deformation at the temperature of this minimum, is considered to be hardly applicable in practice and absolutely unsuitable for determining sensitivity of alloys to crystallization cracks in the weld-adjacent zone.

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34524
S/659/61/007/000/011/044
D217/D303

18.11.20

AUTHORS: Lashko, N.F., Popova, N.M., Orekhov, G.N., and
Vinogradova, Ye.A.

TITLE: Carbo-boride phases in alloy steels

SOURCE: Akademiya nauk SSSR. Institut metallurgii. Issledova-
niya po zharoprochnym splavam, v. 7, 1961, 112 - 121

TEXT: The authors endeavored to find whether carboborides based on
carbide phases of the type $Me_{23}C_6$ can exist in steels. Two varieties
of carbide of the above type have been found in steels: $Fe_{21}W_2C_6$
and $Cr_{23}C_6$. Therefore, two steels were investigated, each contain-
ing one of the $Me_{23}C_6$ types of carbide. The steel 30X2H2BA (30Kh2N
2VA) was used as the $Fe_{21}W_2C_6$ containing material, in which this
compound forms independently, or together with the carbide Me_3C .
Steel 3M268 (EI268) was used as a representative steel containing a
carbide based on $Cr_{23}C_6$. The steels were melted in a high frequency
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S/659/61/007/000/011/044
D217/D303

Carbo-boride phases in alloy steels

furnace of 150 kg capacity and cast into ingots weighing 17 kg in such a manner that each ingot should have a definite boron content. The ingots were forged into rods, which were oil-quenched from 1100 °C. They were then tempered at 600° and 700°C for 30 minutes, 1, 10, 100 and 300 hours. For the separation of the anode deposit from specimens of steel 30Kh2N2VA, electrolytic dissolution for 5 hours in an ice-cold solution consisting of 75 g/l KCl + 5 g/l citric acid was used at a low current density (0.02 A/dm²). The precipitates obtained were analyzed chemically for Fe, Cr and W. For the estimation of B, an anodic deposit was again produced. It was washed with water by decantation, transferred into a conical flask and decomposed with a little H₂SO₄ (1 : 2) with addition of a few drops of H₂O₂. After dissolving the deposit, the solution was boiled until the H₂O₂ was completely decomposed. Small quantities of B were determined calorimetrically, and larger quantities (> 0.1 %) volumetrically. In order to separate the anode deposit from the Cr-Ni steel EI268, anodic dissolution was used in a solution contain-

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Carbo-boride phases in alloy steels

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D217/D303

re changed little on alloying it with B up to 0.23 %. The stress to fracture at 550°C of steel EI268 containing 0.018 - 0.25 % B is somewhat higher than that of boron-free steel. There are 6 figures, 7 tables and 3 non-Soviet-bloc references. The references to the English-language publications read as follows: M.E. Nicholson, J. Metals, 9, no. 1 (section 2), 1957; R. Kiessling, Acta Chem. Scand., 3, 1949.

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X

18.9200

1454, 1045

S/126/61/011/001/017/019
E021/E406AUTHOR: Lashko, N.F.TITLE: A Ternary Phase With an α -Manganese Type Structure in Alloys of the Fe-Ni-Cr-Ti System

PERIODICAL: Fizika metallov i metallovedeniye, 1961, Vol.11, No.1, pp.150-152

TEXT: A ternary phase called the χ -phase with an α -manganese structure has been observed in several chromium-molybdenum steels (Refs.1 to 4). This type of phase was not observed in the Co-Cr-Mo and Ni-Cr-Mo systems (Ref.2) but has been noted in the Co-Cr-Ti system (Ref.7) and in steels containing 12% Cr, 4% Mo and 3% Ti (Ref.8). The possibility of the existence of a similar phase has been investigated in the present work in the systems Ni-Cr-Ti and Fe-Cr-Ti. Ni-Fe-15% Cr-6% Ti alloys containing 0, 20, 40 and 60% Fe were investigated and a phase with the α -Mn structure was found only in the alloy containing 60% Fe after quenching from 1200°C and ageing at 800°C. In the initial stages of ageing, it coexisted with metastable σ -phase, the quantity of which decreased with increasing ageing time. After 100 hours, there was

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S/126/61/011/001/017/019
E021/E406

A Ternary Phase With an α -Manganese Type Structure in Alloys of the Fe-Ni-Cr-Ti System

practically only one phase of the α -Mn type. This phase was unstable at temperatures higher than 800°C. During ageing, the parameter of the crystal lattice changed and was 8.91, 8.88 and 8.86 Å after 25, 50 and 100 hours respectively. The same phase was also detected in a steel containing 0.07% C, 17% Cr, 8.5% Ni and 2% Ti with a parameter of 8.88 Å. The phase was found to be isomorphous with Fe_2Ti and its chemical composition could be written as $(\text{Fe}, \text{Ni}, \text{Cr})_3\text{Ti}$. Acknowledgments are expressed to K.P. Sorokina for her assistance. There are 1 table and 10 references: 4 Soviet and 6 non-Soviet.

SUBMITTED: July 22, 1960

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S/126/61/012/003/013/021
E111/E335

AUTHORS: Lashko, N.F., Orekhov, G.N. and Popova, N.M.

TITLE: Metastable processes in the ageing of heat-resisting pearlitic steel

PERIODICAL: Fizika metallov i metallovedeniye, v. 12, no. 3, 1961, 417 - 423

TEXT: Heat-treatment of pearlitic steel is generally used to produce an initial structural condition giving minimum diffusion-process rates. The number of structural changes possible in the transition of complex, pearlitic, medium-carbon alloy steels from the metastable to the stable state is greater than in low-carbon steels. Control of the process in which diffusion is slowed down to the greatest extent would enable the heat-resistance of the steels to be controlled, which is particularly important for medium-carbon steels with their rapid diffusion processes. Many oil-quenched pearlitic steels develop residual austenite, whose chemical composition and quantity depend on quenching temperature and cooling rate. By changing the paths by which the residual austenite is formed the paths

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E111/E335

Metastable processes

of the carbide transformations in the steels can be changed. The authors have studied this for ~~X2H2BΦA~~ (Kh2N2VFA) steel (actual composition, %: 0.52 Mn; 0.31-0.37 Si; 1.92-1.96 Cr; 1.60-1.69 Ni; 1.22-1.27 W; 0.27-0.30 V, 0.023 S and 0.008 P) with carbon contents of 0.09 - 0.44%. Forged bars were pre-normalized at 980 °C; those of one charge were also pre-quenched from 1 100 °C. After hardening, the bars were subjected to further heat-treatment and short- and long-time strength testing. Phases of the treated specimens were analysed by study of anodic residues, using X-ray structural and chemical analyses. The results show that it is possible to control the decomposition of metastable solid solution in type Kh2N2VFA steels by changing quenching conditions and carbon contents. The residual austenite decomposes on ageing at 500 - 650 °C, forming the special carbides Me_7C_3 , VC and $Me_{21}W_2C_6$. When these steels contain 0.09 - 0.27% carbon, tempering after quenching from 920 and 1 100 °C produces simple carbides (Me_3C , Me_7C_3 , VC); with

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Metastable processes

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E111/E335

0.44% C, ageing at 600 - 650 °C gives the complex carbide of the $Me_{21}W_2C_6$ type after quenching from 920 °C. Preliminary quenching from 1100 °C leads to higher thermal stability because of the higher degree of dispersion of the carbides and relatively higher degree of alloying of the solid solution. On tempering at 500 - 550 °C, the processes retarding plastic deformation predominate over the weak coagulation of the carbide phases. At 600 - 650 °C carbide-formation and growth processes predominate; they occur more rapidly in steels with higher carbon contents and produce loss of strength in the solid solution and also loss of thermal stability of the steels. There are 3 figures, 3 tables and 3 references: 2 Soviet-bloc and 1 non-Soviet-bloc. ✓

SUBMITTED: October 5, 1960 (initially)
March 11, 1961 (after revision)

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S/126/61/012/005/024/028
E040/E435

AUTHOR: Lashko, N.F.

TITLE: On the problem of an intermediate phase formation during martensitic transformation of austenite

PERIODICAL: Fizika metallov i metallovedeniye, v.12, no.5, 1961, 773-775

TEXT: It is suggested that the formation of an intermediate ϵ -phase is necessary for all martensitic transformations in steel and ferro-alloys but that, in some cases, the existence of this phase cannot be detected because it occurs in a very narrow temperature range only. A critical evaluation of the available literature data concerning the ϵ -phase is followed by an account of the author's experiments in which the ϵ -phase was isolated by anodic separation in an electrolyte containing 300 g KCl, 50 g ammonium citrate and HCl in the concentration of 50 ml/litre. The current density was 1 amp/cm². Data are reported of X-ray structural analysis of the deposit in copper K α radiation. The specimen was quenched from 1050°C. After heating of quenched steel at 760°C for 90 minutes, the presence was detected of the

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On the problem of an intermediate ... S/126/61/012/005/024/028
EG40/E435

nuclei of the carbide phase Me_2C_6 . Because of carbon depletion, the austenitic phase γ was even more unstable and most of it was converted into martensite, whose segregations could be clearly seen in aged steel. The anodic deposit obtained from aged steel showed the presence of Me_2C_6 only. Obviously, in the steel investigated martensite differs little in its electrode potential from austenite, whereas the electrode potential of the ϵ -phase differs sharply from that of austenite. It is concluded that a non-diffusional transformation of the close-packed face-centred cubic structure passes in the process of quenching into a similar structure but of the hexagonal type. Further decomposition of this structure is accompanied by the formation of the tetragonal structure of martensite. It is suggested that further investigations should be carried out on the ϵ -phase structure. There are 1 table and 11 references: 2 Soviet-bloc and 9 non-Soviet-bloc. The four most references to English language publications read as follows: Ref.3: Parr I.G. J. Inst. Metals, v.81, 1952, 214; Ref.6: Cina B. J. Iron and Steel Inst., v.177, 1954, 406; Ref.8: Otte H.M. Acta met., v.5, 1957, 614.

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On the problem of an intermediate ... S/126/61/012/005/024/028
E040/E435

Ref.10: Cina B. Acta Met., v.6, 1958, 748.

SUBMITTED: April 11, 1961

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22947
S/125/61/000/006/005/010
D040/D112

1:2300

AUTHORS: Lashko, N. F., Lashko-Avakyan, S. V. (Moscow)

TITLE: Crystallization cracks in welding

PERIODICAL: Avtomaticheskaya svarka, ^{V14}no. 6, 1961, 37-46

TEXT: Available data on cracking in fusion welding are examined and some theories disproved, in particular the theory by B. A. Movchan (Ref.5 and 15: "Avtom. svarka", no. 6, 1959; "Izvestiya AN SSSR. Metallurgiya i toplivo", no. 5, 1959; and DAN SSSR, vol 120, no. 3, 1958). Movchan's theory concerned crack formation in single-phase austenite steel welds. Its essence: cracks form on crystallites boundaries in solid state, spread to the crystallization front and are filled with liquid metal from the welding pool. The authors consider this case possible but just as a particular and even rare case, and prove that boundaries between joining crystallites forming during crystallization may or may not pass along the segregation spaces between growing dendrites (Fig. 2) and can sometimes be revealed only owing to different susceptibility to etching in adjacent grains. An example is aluminum with 1.5 and 2.5% Cu studied by the authors, where the crystallite boundaries had

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Crystallization cracks in welding

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the form of thin, clear lines (Fig. 5), probably due to a higher content of Cu and impurities in them. In aluminum with more Cu (3.5 and 5.8%) the structure became polyhedral, no fine boundary lines or segregation spots were visible and cracking susceptibility was reduced. The crystallization of stannum and several steel grades is discussed and illustrated by photomicrographs proving that grain boundaries can be located differently. It is pointed out that crystallization cracks may form between dendrite axes and not on the boundaries. This is evident in welds made on cast weldable БЛ 7-20 (VL7-20) steel (Fig. 9) by austenitic X20H10Г6А (Kh20N10G6A) steel electrodes. Cracks started in it on the crystallite boundaries and spread into the interaxial segregation area within the crystallite, and the crack came out to the fusion line between the weld and base metal and penetrated only where it met low-melting interaxial dendrite areas. Cracks that did not cross the fusion line did not spread into base metal. Cracks spread along boundaries that did cross segregation areas as well as along those that did not cross it (Fig. 10). It is advised to avoid welds with clear crystallite boundaries not coinciding with segregation areas, particularly when carbides, sulfides and other compounds are segregating on the boundaries. Austenitic alloys being welded must contain as little carbon, sulfur, phosphorus, silicon or other matters

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Crystallization cracks in welding

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that reduce the crack resistance as possible, or else they must be alloyed with elements reducing segregation, i.e. titanium, columbium, manganese. Boron has a very complex effect, i.e. forms borides, dissolves in only very low quantities. In austenitic steel with low boron content the cracking can be suppressed either by reducing the boron content in welds below its solubility point by using a boron-free filler alloy, or binding boron into high-melting eutectics. Molybdenum and tungsten are such binding elements, and the $(Cr,Mo)_5B_4$ and $(Cr,W)_5B_4$ boride compounds are high-melting. The authors consider tungsten more effective than molybdenum, for it raises the iron melting point and concentrates in the dendrite axes, whilst molybdenum slightly lowers the iron melting point and concentrates mainly in interaxial spaces. No crystallite boundaries were observed in welds in austenite steel produced by the most suitable electrodes - X 16425M6 (Kh16N25M6) with high Mo content, and 9N -869 (EI-869) or BWC-98 (VZh-98) high W-content. In such welds the boundaries appear to be dislocations and they are only visible after heating subsequent to welding (due to diffusion of impurities or carbon into boundaries). There are 10 figures and 15 references: 13 Soviet-bloc and 2 non-Soviet bloc.

SUBMITTED August 20, 1960

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18 9200 1418, 1045
18 1250 1446, 1454

S/032/61/027/003/001/025
B118/B203

AUTHORS: Blok, N. I., Lashko, N. F., and Khromova, O. A.

TITLE: Phase analysis of nickel beryllium alloys

PERIODICAL: Zavodskaya laboratoriya, v. 27, no. 3, 1961, 251-252

TEXT: Ni-Be-alloys with 2% of Be are aging systems. Aging is conducted under essential changes distorting the original crystal lattice and determining the mechanical properties of the alloy. It is the purpose of the present paper to clarify this relationship as far as possible. Investigations were made on three alloys of the following compositions: 1) 1.93% Be, residue Ni; 2) 2.20% Be, 5.0% Mo, residue Ni; 3) 2.66% Be, 1.18% W, residue Ni. The alloys were heated to 1080°C, and hardened in water. The individual specimens were aged at certain temperatures between 300 and 800°C for 6 hr. The phases of the pretreated alloys were separated by electrolysis (electrolyte: 10 g of triammonium citrate dissolved in 1200 ml of 12% NH₄OH; current density 0.06 a/cm²; room temperature). The resulting anodic precipitates were subjected to chemical and X-ray structural analyses. One NiBe phase and one solid solution poor in Be each were obtained from alloys (1)

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Phase analysis ...

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B1 18/B203

and (3) (from (1) at an aging temperature of 300°C, from (3) at 500°C and over). Only one NiBe phase was isolated from alloy (2). The content of NiBe in the alloy changes with the aging temperature (in (1), increase of 1.08% at 300°C to 2.83% at 800°C; in (3), increase of 3.36% at 300°C to 5.47% at 800°C; in (2), decrease from 5.10% at 300°C to 4.13% at 800°C). The NiBe compound has a regular cubic crystal lattice of the CsCl type. The stoichiometric ratio is not strictly maintained. NiBe particles which are coarse after hardening become very fine in aging at 300°C, and are enlarged again at higher aging temperatures. The strongly blurred lines of X-ray patterns of specimens treated at 300-500°C indicate an intense distortion of the crystal lattice of two solid solutions. On the basis of these findings, the authors consider the interaction of the following independent processes to be decisive for the mechanical characteristics of the alloys studied: block formation within the solid solution; distortion of crystal lattices of solid solutions; separation of a NiBe phase of different dispersion degrees (according to aging conditions). Maximum strength of the Ni-Be-Mo alloy was attained at an aging temperature between 400 and 500°C. A. A. Burmistrova, Ye. A. Vinogradova, and K. V. Smirnova assisted in the experiments. There are 3 tables.

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18-9200

27832
S/032/61/027/010/002/022
B110/B101

AUTHORS: Blok, N. I., Kishkin, S. T., Kozlova, M. N., and Lashko, N. F.

TITLE: Phase analysis of surface layers of heat-resistant nickel alloys

PERIODICAL: Zavodskaya laboratoriya, v. 27, no. 10, 1961, 1185-1189

TEXT: The methods based on a total determination of the chemical composition of the test layer used so far for investigating surface layers of alloys heated in air are insufficient for studying the processes taking place. For this purpose, the authors elaborated a method of phase analysis in layers, and were able to determine the distribution of alloying elements among the individual phases, their nature and content in each layer. 8 - 10 anode deposits taken by layers and the corresponding portions of electrolyte were analyzed chemically. From another sample anode deposits are separated in layers for X-ray structural analysis. By micrometer and calculation by weight of the metal dissolved, the layer depth was determined as being ~0.005 to 0.05-0.06 mm. Uniform dissolution on the entire sample surface is necessary. A crystallizer holding ~350 ml

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Phase analysis of surface layers of ...

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poor in alloying elements) is not dissolved at EI617, and only selectively at EI437. When operating with 18, the boundary between layers II and III may be determined owing to the appearance of the α' -phase in the anode deposit. Layer II of EI617 is dissolved in 81 under continuous control of the solubility in 18. For this purpose, the analytically weighed sample is immersed in 18 and, unless it dissolves here, it is dissolved for ~ 10 min in 81, the deposit is removed, dried, weighed, and the cycle is repeated up to dissolution and separation of the α' -phase in 18. Layer III consisting of solid solution (poor in alloying elements) and α' -phase on the basis of $\text{Ni}_3(\text{Al}, \text{Ti})$, as well as layer IV of initial alloying composition, are dissolved in 18. The anode deposit separated in 18 and 81 (layer II, EI617) is filtered off and washed out with 0.2% electrolyte solution up to negative Ni^{2+} reaction. Electrolyte and rinsing water are united, evaporated, filled up to 200-250 ml; 50 ml of it is mixed with 10 ml H_2SO_4 (1.84) and heated. H_2O_2 is added to the dark-brown liquid obtained. It is heated up to destruction of H_2O_2 , filled up to 100 ml, and the elements are determined. Anode deposit I is molten with KHSO_4 , the

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melt is dissolved in 5% H_2SO_4 , and filled up to 200-250 ml. According to X-ray structural and chemical analyses, layer I (up to 0.005 mm depth) is strongly enriched with Cr, Al, and Ti. It consists of Me_2O_3 (Cr_2O_3 , Al_2O_3 , $NiO \cdot TiO_2$) with trigonal crystal structure, the parameters of which are similar to those of Cr_2O_3 . In layer II (in ~ 0.027 mm depth of EI 437 and in ~ 0.40 mm depth of EI617), as in layer I, α' - and carbide phases are destroyed through Cr-, Al-, Ti and C diffusion to the periphery, and the oxides are formed. Layer III is ~ 0.10 mm depth in EI437 and ~ 0.15 mm in EI617. In EI437, the Me_2O_3 are enriched with Cr in peripheral layers, and with Al in deeper ones. In EI617, Al_2O_3 already exists at small depth, which suggests a missing equilibrium state. Gas turbine blades of EI437A (EI437A) operating at $\leq 700^\circ C$, where uniform dissolution was difficult, were tested in this way. Layer I was missing (mechanical wear). Impoverishment in chromium was found down to 0.075 mm. The Ti content of the surface layer was constant. The Al enrichment at a certain depth cannot be explained. Destruction processes on the surface starting at the grain

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Phase analysis of surface layers of ...

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boundaries are explained by deep oxygen diffusion along the grain boundaries. N. M. Rudneva, N. A. Shumilina, K. V. Smirnova, and A. N. Sokolov assisted in the experiments. There are 3 figures, 2 tables, and 4 references: 3 Soviet and 1 non-Soviet.

Card 5/5

BLOK, N.I.; GLAZOVA, A.I.; LASHKO, N.F.; KURAYEVA, V.P.; MOLCHANOVA, Ye.K.;
Prinimali uchastiye: VINOGRADOVA, Ye.A.; ZVONTSOVA, Ye.V.;
POLYAKOVA, L.V.

Phase analysis of alloys on the titanium basis. Zav. lab. 27
no. 12:1470-1472 '61. (MIRA 15:1)
(Titanium alloys) (Phase rule and equilibrium)

BOKSHTEYN, S.Z. (Moskva); KISHKIN, S.T. (Moskva); LOZINSKIY, M.G. (Moskva);
SOKOLKOV, Ye.N. (Moskva); Prinimali uchastiye: PODVOYSKAYA, O.N.;
ZILOVA, T.K.; SOROKINA, K.P.; POLYAK, E.V.; MOROZ, L.M.;
BULYGIN, I.P.; LASHKO, N.F.; POKAMESTOVA, T.N.; GORDEYEVA, T.A.;
YAGLOV, R.V.; VOLODINA, T.A.; KORABLEVA, G.N.; ANTIPOVA, Ye.I.

Thermomechanical treatment of chromium-nickel-manganese
austenitic steel. Izv. AN SSSR. Otd. tekhn. nauk. Met. i topl.
no.2:15-21 Mr-Ap '62. (MIRA 15:4)
(Chromium-nickel steel--Hardening)

35696
S/129/62/000/004/009/010
E073/E535

18.1285
AUTHORS: Molchanova, Ye.K., Engineer and Lashko, N.F.,
Candidate of Technical Sciences
TITLE: Braking of eutectoidal composition in chromium
containing titanium-aluminium alloys
PERIODICAL: Metallovedeniye i termicheskaya obrabotka metallov,
no.4, 1962, 54-56

TEXT: The influence of isomorphous β -stabilizers
(molybdenum, vanadium, niobium and tantalum) on the stabilization
of the titanium β -phase during ageing was investigated.
Molybdenum, vanadium, niobium and tantalum were added to the base
alloy (Ti-5Al-2Cr) in quantities of 1 to 4%. The chemical
compositions of the alloys, in %, as well as the phase composition
after ageing at 500°C for 100 hours, are given in Table 1. Ingots
weighing 5 kg were produced in an arc furnace with consumable
electrodes by double re-smelting and were then forged into
12 mm diameter and 10 x 10 mm rods. Prior to forging the ingots
were heated to 1000°C. All the alloys deformed satisfactorily
in the hot state and proved thermally stable at 400°C. At 400
Card 1/2

LASHKO, N.F., kand.tekhn.nauk; CHATYNYAN, L.A., inzh.

Effect of structure and phase constitution on the wear-resistance
of nickel alloys. Metalloved. i term. obr. met. no.7:20-23
Jl '62.

(MIRA 15:6)

(Nickel alloys--Testing)
Phase rule and equilibrium)

TEREKHOV, K.I.; LASHKO, N.F.; SOROKINA, K.P.

Phase constitution, structural transformations and heat resistance
in chromium-nickel-manganese steel. Issl.po zharopr.splav.
8:155-161 '62. (MIRA 16:6)

(Steel, Heat-resistant--Metallography)
(Phase rule and equilibrium)

LASHKO, N.F., kand.tekhn.nauk; LASHKO, S.V., kand.tekhn.nauk

Increasing the corrosion resistance of aluminum alloy
weldments made with fusible solders. Svar. proizv.
no.12:29-30 D '62. (MIRA '15:12)
(Aluminum alloys—Corrosion)
(Solder and soldering)

LASHKO, N.F.; SOROKINA, K.P.

Hardening phases in aging chromium-nickel steels alloyed
with titanium and aluminum. Fiz. met. i metalloved. 14 no.1:121-124
Jl '62. (MIRA 15:7)

(Chromium-nickel steel—Hardening)

S/032/62/028/007/011/011
B117/B101

AUTHORS: Blok, N. I., Lashko, N. F.

TITLE: Conference on the phase analysis of metals and alloys

PERIODICAL: Zavodskaya laboratoriya, v. 28, no. 7, 1962, 893

TEXT: A conference on methods of phase analysis and the application of this to metallography was held in Moscow from November 28 to December 1, 1961 attended by 350 representatives of institutes and industrial laboratories in various fields. 36 reports were presented. In one on the importance of phase analysis in metallography, I. I. Kornilov described the historical development of this method. I. Ye. Lev, A. F. Platonova, N. G. Roslyakova, O. S. Spiridonova, and M. N. Obraztsova reported on carbide analysis of high-carbon iron alloys, transition and heat-resistant steels. Among other reports were the following: L. V. Zaslavskaya, N. Ya. Karasik, N. Ye. Shlepyanova, and E. I. Belikova on the analysis of intermetallic phases in steels. N. L. Belyakov and V. S. Mal'tseva on the analysis of austenite-ferrite steels. O. A. Khromova, K. P. Sorokina, M. N. Kozlova, and M. M. Shapiro on the phase analysis of

Card 1/2

Conference on the phase analysis...

S/032/62/028/007/011/011
B117/B101

nickel alloys. A. I. Glazova and N. F. Lashko on the phase analysis of titanium alloys. O. A. Khromova on the methods of phase separation in aluminum alloys. I. Ye. Lev and V. S. Mal'tseva on general problems of the electrochemical theory of phase separation in steels. K. P. Sorokina on experimental data on the study of $Ni_3(Al,Ti)$ and carbide phases. Reports on analytic methods without phase separation included those by L. S. Palatnik on the electronographic investigation of thin layers, by S. Z. Bokshteyn on radiographic methods; by V. Ye. Rudnichenko on local X-ray structural analyses; by L. L. Kunin on thermal extraction. It was resolved to organize and coordinate further studies on the phase analysis of various alloys.

Card 2/2

L 10349-63

ENP(k)/ENP(q)/ENT(m)/BDS AFTG/ASD
PHASE I BOOK EXPLOITATION

Pf-4 JD/HM/JG
SOV/6402

69
61

Lashko, N. F., and S. V. Lashko.

Nekotoryye problemy svarivayemosti metallov (Some Problems of Metal Weldability). Moscow, Mashgiz, 1963. 299 p. Errata slip inserted.
4000 copies printed.

Reviewer: F. Ye. Tret'yakov, Candidate of Technical Sciences;
Ed. of Publishing House: L. A. Osipova; Tech. Ed.: V. D. El'kind; Managing Ed. (for literature on hot treatment of metals): L. A. Osipova, Engineer.

PURPOSE: This book is intended for scientific workers and engineers concerned with the study of metals and alloys and the development of welding technology.

COVERAGE: The book reviews some problems of weldability of metals in fusion welding. The problem of weld quality is reviewed in conjunction with nonequilibrium crystallization, and with the degree and character of heterogeneity of the structure being

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L 10349-63
Some Problems of (Cont.)

SOV/6402 4

formed during weld formation. General conditions leading to the formation of crystallization, subsolidus, and quench [cold] cracks are discussed. The problem of the strength, brittleness, and ductility of welded joints is reviewed in conjunction with structural transformations in the heat-affected zone. Basic problems are illustrated with examples of typical monomorphous aluminum-, copper-, and molybdenum-base alloys as well as of polymorphic titanium-base alloys. No personalities are mentioned. There are 344 references: 208 Soviet, and 136 non-Soviet.

TABLE OF CONTENTS:

Foreword

Introduction

3

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Card 2/8

LASHKO, N.F., kand.tekhn.nauk; LASHKO, S.V., kand.tekhn.nauk

Solder activation for stainless steels. Svar. proizv. no.2:17-19
F '63. (MIRA 16:2)
(Steel, Stainless—Welding) (Solder and soldering)

LASHKO, N.F.

ID Nr. 991-3 17 June

BRITTLE-CRACK ARRESTING (USSR)

Kelekhsayev, V. Ya., and N. F. Lashko. Avtomaticheskaya svarka, no. 3, 1963, 13-20. S/125/63/000/003/003/012

The ability of ductile interlayers to arrest brittle-crack propagation in steels has been investigated. The ductile interlayers were produced by face-to-face copper brazing of two steel plates and rolling the composite plate to a thickness of 26 mm for flat specimens, or by copper brazing a round steel bar into a hollow steel cylinder for round specimens. For round specimens 30X1CA steel [Cromansil] was used; for flat specimens, a high-strength alloy steel [unidentified]. Specimens were austenitized at 870°C, oil-quenched, and tempered at 200-600°C for 2 hrs. Tests at room temperature revealed that in both flat and round specimens the copper interlayers lowered the tensile strength somewhat—for instance, from 136 to 115-129 kg/mm² for 30X1CA steel tempered at 450°C and from 152.8 to 137.2-149.1 kg/mm² for the other steel tempered at 450°C. Elongation was not affected, but the reduction of area of round specimens tempered as above increased from 32 to 49%. The

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AID Nr. 991-3 17 June

BRITTLE-CRACK ARRESTING [Cont'd]

8/125/63/000/003/003/012

notch toughness of the unidentified steel tempered at 200°C was found to depend upon the distance between the crack arrester and the notch bottom. It varied from 25 kg-m/cm² with the notch bottom just touching the crack arrester to 7.5 kg-m/cm² with the notch bottom 3 mm from the crack arrester; the notch toughness of specimens without crack arrester was 4 kg-m/cm². The crack arrester perpendicular to the notch bottom did not improve the notch toughness. In static bending, the notched specimens with the crack arrester at a certain distance (up to 2 mm) from the notch bottom resisted brittle fracture better. At 500°C under stresses of 65 and 70 kg/mm² the specimens with crack arrester tempered at 200°C had a rupture life of 8700 and 135 sec, respectively, whereas solid specimens under stresses of 69.5 and 58 kg/mm² had a rupture life of 25 and 293 sec. The endurance strength of the specimens with crack arresters was considerably lower than that of solid specimens.

[ND]

Card 2/2

AID Nr. 983-12 12 June

BRITTLE INTERLAYER IN BRAZED JOINTS (USSR)

Lashko, N. F., and S. V. Lashko. Avtomaticheskaya svarka, no. 4, Apr 1963, 34-40. S/125/63/000/004/006/011

Factors causing the formation of a continuous brittle intermetallic layer in the brazing-alloys—base-metal interface and the penetration of liquid brazing alloy into base metal along grain boundaries have been studied. Analysis of data from the literature and of the results of extensive experiments showed that such brittle layers are formed only in joints solidifying according to a peritectic reaction (both independent of and associated with a eutectic reaction) with the formation of incongruent chemical compounds and only when the solubility of the compound components in the base metal at the brazing temperature is low. Brittle interlayers are formed, for instance, when Cu-, Fe-, and Ni-base or Ag-rich brazing alloys are used for brazing Ti; Cd-base alloys, for brazing Ni; or Ni and Cu-Ni alloys, for brazing Nb. Congruent chemical compounds do not form continuous

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AID Nr. 988-12 12 June

BRITTLE INTERLAYER [Cont'd]

S/125/63/000/001/005/011

layers. Formation of the continuous brittle layers in brazed joints can be prevented by avoiding, or at least by shortening the duration of, contact between base metal and liquid brazing alloy by means of suitable in-between coatings, by brazing at the lowest possible temperature, and by a precise dosing of the brazing alloy. The last can be achieved by using the alloy in the form of thin foil or wire mesh. The intergranular penetration of the liquid phase into the base metal takes place only when the brazing alloy contains a component which forms a eutectic with the base metal, and only when this component possesses a low solubility in the base metal. Otherwise the intergranular penetration of the liquid phase into the base metal will take place only after the base metal is saturated with the alloying element, i. e., after the formation of a solid-solution layer, which will retard the penetration process.

[M]

Card 2/2

L 18378-63

EWf(k)/EWf(q)/EWf(m)/BDS

AFFTC/ASD Pf-4 JD/HM
S/0125/63/000/006/0030/0035

ACCESSION NR: AP3002316

AUTHOR: Lashko, N. F. (Moscow); Lashko, S. V. (Moscow)

TITLE: Interaction between brazing alloy and base metal. 2. Dissolution of the base metal during brazing

SOURCE: Avtomaticheskaya svarka, no. 6, 1963, 30-35

TOPIC TAGS: brazing, base metal erosion, precautionary measures, base metal dissolution, types of reaction, dissolution rates

ABSTRACT: In an attempt to find ways of reducing the dissolution of the base metal by the molten brazing alloy during brazing, an investigation was made of the physicochemical phenomena occurring under conditions approximating those of capillary brazing and dip brazing. In the first case, in which the volume of the brazing metal was small as compared with that of the base metal, the rate of dissolution was calculated from the depth of fusion of the base metal in fillet regions in a certain time period; in the second, it was determined by the increase in weight per unit of original surface of the specimen per unit of time after immersion in a bath of liquid brazing metal. Three basic patterns of dissolution-rate temperature were determined: 1) continuous increase (in case

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L 18378-63
ACCESSION NR: A3002316

of formation of solid solutions or eutectics); 2) overall increase, but with temporary decrease within a limited range of median temperatures (when there is an excess of brazing alloy and the base metal and the brazing alloy form inter-metallic compounds); and 3) initial steady increase, with subsequent steady decrease (when there is a limited quantity of brazing alloy). Nickel brazed with copper or with nickel-beryllium or nickel-boron eutectic alloys; copper brazed with copper-phosphorus eutectic alloy; and aluminum brazed with zinc behave according to pattern 1. Pattern 2 is observed in dip brazing of copper with tin or cadmium, or nickel with cadmium; and pattern 3, in brazing VT-1 commercial-grade titanium with PSr72 [silver-base] alloy, or EI-437 [Nimonic 80A] alloy with alloys of the Ni-Cr-Mn system. The rate of dissolution of the base metal by the brazing alloy can be reduced by 1) limiting the time of contact between the liquid brazing alloy and the base metal; 2) keeping the brazing temperature as low as possible; 3) limiting the alloying of the base metal by the brazing-alloy components; 4) refraining from the use of a single, low melting metal as the brazing alloy, and using, instead, its alloys (for example, eutectic) with the base metal (such alloys flow better into the capillaries and dissolve the metal surfaces to be joined to a lesser extent); 5) brazing only those metals which form a wide range of solid solutions with the brazing alloy; and 6) carefully

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L 18378-63

ACCESSION NR: AP3002316

0

measuring out the amounts of brazing alloy to be used. Orig. art. has: 5 figures.

ASSOCIATION: none

SUBMITTED: 04Apr62

DATE ACQ: 12Jul63

ENCL: 00

SUB CODE: 00

NO REF SOV: 003

OTHER: 000

0

Cord 3/3

ACCESSION NR: AT4007052

S/2598/63/000/010/0293/0299

AUTHOR: Vinogradova, Ye. A.; Lashko, N. F.; Moiseyev, V. N.

TITLE: Formation of metastable phases and its effect on the properties of alpha and beta titanium alloys

SOURCE: AN SSSR. Institut metallurgii. Titan i yego splavy*, no. 10, 1963. Issledovaniya titanovy*kh splavov, 293-299

TOPIC TAGS: titanium alloy, alpha beta titanium alloy, titanium alloy property, VT-14 titanium alloy, VT-14-1 titanium alloy, phase transformation, metastable phase formation, metastable phase, alloy phase composition

ABSTRACT: The authors point out that the Ti alloys VT-14 and VT-14-1 are characterized by large amounts of stable and metastable β phases, and that rapid quenching of VT-14 leads to the formation of the martensitic α' phase while VT-14-1 (containing more Mo and V) forms α' or α and β phases depending on the cooling rate. The present paper is devoted to an X-ray analysis of the phase transformations in these two Ti alloys, and to a study of their effect on the mechanical properties of the alloy. The effect of quenching from various temperatures on the mechanical properties of VT-14 is shown in Fig. 1 of the Enclosure, indicating that the strength increases with increasing quenching temperature while the yield point

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ACCESSION NR: AT4007052

passes through a minimum. While investigating the reason for this decrease in yield point, the authors found that the lattice parameter of the β -phase increases with quenching temperature in monolithic samples, but is constant in the β -phase isolated from VT-14 alloys. They therefore conclude that the decrease in yield point of quenched Ti alloys is due to an increase in the amount and stability of the β -phase, which is destroyed during plastic deformation. The authors go on to investigate the effect of destruction of the metastable β - and α' -phases on the phase composition and properties of an $\alpha + \beta$ Ti alloy, demonstrating that the proportions of the α -, α' -, α'' -, β - and ξ -phases in the final alloy depend on the heating temperature and cooling rate. As the heating temperature and cooling rate are increased, the structural metastability of the alloy increases, resulting in turn in a lower yield point and the formation of a metastable β phase which decomposes to the α' phase and even the $\alpha(\alpha') + \beta$ phase during subsequent aging. At almost all temperatures, isothermal aging results in a lowered yield point and increased plasticity. Finally, the authors discuss the reversibility of this transformation ($\beta \rightarrow \alpha'$) and the metastable transformations taking place in Ti alloys during plastic deformation (cold rolling); the latter process seems to induce transformation of β into α' and then α' after quenching from 750C, but the reverse (at least for a deformation of no more than 5%) after quenching from 850C; 20% deformation after quenching from 850C again results in $\beta \rightarrow \alpha'$ transformation. The effect of plastic deformation on the mechanical properties of these metastable

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ACCESSION NR: AT4007052

alloys was somewhat unusual, in that the yield point of an alloy containing 7.1% Mo and 2.3% Al and quenched from 750C decreased and the % elongation increased (both irregularly) with increasing deformation (0-25%). Orig. art. has: 6 tables and 5 figures.

ASSOCIATION: Institut metallurgii AN SSSR (Metallurgical Institute, AN SSSR)

SUBMITTED: 00

DATE ACQ: 27Dec63

ENCL: 01

SUB CODE: MM

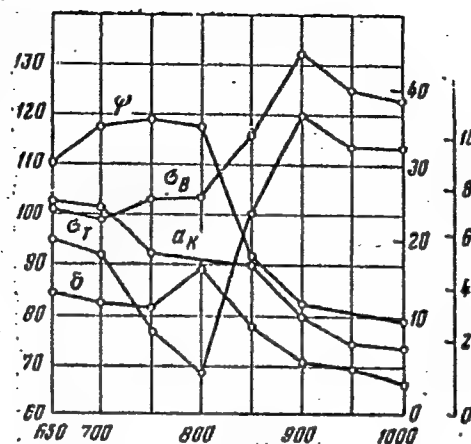
NO REF SOV: 001

OTHER: 001

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ACCESSION NR: AT4007052

ENCLOSURE: 01



Changes in the mechanical properties of alloy VT-14 after quenching in water from various temperatures.

Ordinate = kg/mm² on the left and kg·m/mm² on the right; abscissa = quenching temperature in °C.

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1 17084-63 EMP(q)/ENT(m)/BDS AFFTC/ASD JD

ACCESSION NR: AP3004593

S/0126/63/016/001/0065/0070

AUTHORS: Gusev, Ye. V.; Lashko, N. F.; Khatsinskaya, I. M. 60

TITLE: Anomalous electrical resistivity variation in titanium alloys of a transition class 16 27

SOURCE: Fizika metallov i metallovedeniye, v. 16, no. 1, 1963, 65-70

TOPIC TAGS: titanium alloy, electrical resistivity

ABSTRACT: The chemical composition and structure of the following titanium alloys were studied: VT1 (commercial titanium); VT5- 3.9% Al; VT6- 5.7% Al and 3.8% V; VT14-1 - 1.9% Al and 6.8% Mo; VT15- 3% Al, 11% Cr and 7% Mo. It was established that the electrical resistivity of α - and $\alpha + \beta$ titanium alloys is determined basically by the relation between the α , α' , α'' and β phases formed during heating or cooling. The intraphasal processes and phasal transformations of the alloys were determined according to the variation in their electrical resistivity. The results obtained with heating of samples up to 1000C and a subsequent cooling to room temperature are shown graphically. A decrease in electrical resistivity with the increase in temperature was observed in the alloy VT15 which (after 16

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L 17084-63

ACCESSION NR: AP3004593

hardening) had the structure of the metastable β -phase. The latter was subsequently decomposed into β + α phases during aging. This anomalous variation in electrical resistivity was explained by the local martensitic transformation of a specific kind and by a partial or a total variation in the nature of chemical bonds. Orig. art. has: 4 figures and 1 table.

ASSOCIATION: none

SUBMITTED: 07Jun62

DATE ACQ: 27Aug63

ENCL: 00

SUB CODE: ML

NO REF SOV: 001

OTHER: 003

Card 2/2

S/032/63/029/003/002/020
B117/B186

AUTHORS: Kozlova, M. N., Lashko, N. F., and Sorokina, K. P.

TITLE: Phase analysis of nonferrous alloys

PERIODICAL: Zavodskaya laboratoriya, v. 29, no. 3, 1963, 261-271

TEXT: Western and Soviet literature on the phase analysis of nonferrous alloys for the period 1931-1961 are reviewed. The phase analysis of nickel, cobalt, chromium, copper, titanium, niobium, zinc, aluminum, and magnesium alloys, and methods of chemical phase separation in anode slime are described. There are 100 references.

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S/032/63/029/003/003/020
B117/B186

AUTHORS: Blok, N. I., Kozlova, M. N., and Lashko, N. F.

TITLE: Phase analysis of chromium-plated nickel alloys

PERIODICAL: Zavodskaya laboratoriya, v. 29, no. 3, 1963, 272-276

TEXT: The method of phase analysis by layers was used to study the phase composition and the general chemical composition of the surface layer of heat-resistant chrome nickel alloys. It consists in the successive anodic dissolution of thin layers whose composition differs by reason of the weakening of diffusion processes with increasing depth as well as in the chemical analysis of the anode slime and the corresponding amount of electrolyte. An alloy of the type β W4375 (EI437B) (Ti-Al-Cr) and a composite alloy of higher aluminum content were studied. Electrolytes with ferrochrome or with metallic chromium were used at 1100°C for 10 hrs. The composition of the surface layer growing on the specimen depended considerably on the composition of the electrolyte. In both cases the surface layer was enriched with bound nitrogen in the form of nitrides and in solid solution due to the effect of atmospheric nitrogen, the chromium

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S/032/63/029/003/003/020

B117/B186

Phase analysis of chromium-plated ...

acting as catalyst. An analysis of the thin layers showed: In the chromium-plating of EI437B with ferrochrome, Fe_2O_3 and Cr_2O_3 are formed in the thin top layer and nitrides, mainly titanium nitride, in those following. The nitride shows a high content of chromium in the layers near the surface. Using metallic chromium, Cr_2N and CrN are formed in the top layers and titanium nitrides mixed with chromium in those below. The chromium content decreases with increasing depth; only pure titanium nitrides occur in the lower layers. The content of nitrides decreases at a depth of $> 150\mu$, and the initial composition and structure of the alloy appear at $\sim 280\mu$. In the chromium-plating of the composite alloy, aluminum nitride is formed besides chromium and titanium nitrides. The original composition of the alloy is only found at a considerable depth. There are 1 figure and 3 tables.

Card 2/2

VINOGRADOVA, Ye.A.; GLAZOVA, A.I.; LASHKO, N.F. (Moskva); Prinimali
uchastiye: GUS'KOVA, Ye.I.; POLYAKOVA, L.V.

Using anodic phase isolation for determining the solubility of
some elements in the α -phase of titanium alloys. Zhur. fiz.
khim. 37 no.12:2734-2739 D '63. (MIRA 17:1)

LASHKO, S.I., kand. tekhn. nauk; LASHKO, N.P., kand. tekhn. nauk

Reply to the article by L.I. Il'yevskii "Drawback of research
papers on welding." Svar. proizv. no.5:39-40, 45 My '64.
(MIRA 18:11)

L 16587-65 EWT(m)/EPF(n)-2/ENP(t)/ENP(b) Pu-4 ASD(m)-3/AS(mp)-2/AFTC(p)
JD/WW/JG/MLK

ACCESSION NR: AT4048054

S/0000/64/000/000/0074/0079

AUTHOR: Lashko, N. F.

TITLE: The metastable polymorphism of alloys based on elements from Group IV of the Periodic Table

SOURCE: Soveshchaniye po metallurgii, metallovedeniyu i primeneniyu titana i yego splavov. 5th, Moscow, 1963. Metallovedeniye titana (Metallography of titanium); trudy* sovsshchaniya. Moscow. Izd-vo Nauka, 1964, 74-79

TOPIC TAGS: alloy structure, alloy polymorphism, metastable polymorphism, eutectoid, martensitic transformation, zirconium alloy, niobium alloy

ABSTRACT: Alloys, on being quenched from temperatures in the β -phase region, may undergo several types of metastable polymorphic transformations. The conditions of the transformations may, according to previous articles, be predicted by the formula

$$\frac{(100-x) \cdot 4 + x(4+y)}{100} = 4 + \frac{xy}{100} = a_i (i = 2, 3, 4), \quad (1)$$

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L 16587-65

ACCESSION NR: AT4048054

where i is 2, 3, or 4; a_i is a constant of the i th transformation; x is the at. % of the alloying element, and y is the number of internal electrons of said element less four. Since certain experimental data seem to defy or at least exceed the limits of this formula, the author wished to find a more inclusive means of determining the existence of the metastable transformations. It seems, for earlier experiments, that when the temperature of the eutectoid transformation approaches that of the polymorphic transformation $\beta \rightarrow \alpha$ in the pure metal, the conditions favorable to a whole series of metastable transformations are fulfilled. This can be verified by data from the literature. The actual formation of a β -phase can also be predicted by the eutectoid temperature: if it is too high, no β -phase will be formed. In titanium and zirconium alloys, the metastable reaction $\beta \rightarrow \beta + \omega$, which occurs in quenching or during aging, has a specific relationship to the martensite transformation, since this depends on the existence of the ω -phase. In the present work, 4 Zr-Nb alloys ranging from 6 to 20% Nb were quenched in water from temperatures of 750-880C and aged at temperatures of 400-550C for periods of 0.5-50 hours. Alloys containing 8% Nb, when quenched from 880C and studied immediately or when aged at 400 and 430C for 2 and 0.5 hours, respectively, showed the

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L 16587-65

ACCESSION NR: AT4048054

2

$\beta \rightarrow \beta + \omega$ reaction, but showed no such reaction when aged at 550C, thus verifying previous conclusions. "Ye. A. Vinogradova and A. I. Glazova took part in the work."
Orig. art. has: 5 tables, no graphs.

ASSOCIATION: none

SUBMITTED: 15Jul64

ENCL: 00

SUB CODE: MM

NO REF SOV: 012

OTHER: 000

Cord 3/3

L-42285-65 EWA(c)/EWT(m)/EWP(b)/I/EWP(t) IJP(c) JD

ACCESSION NR: AP4030394

8/0021/64/000/004/0502/0505

22
B

AUTHOR: Lashko, M. F.

TITLE: Reversible martensitic transformations of a special kind in titanium Alpha plus Beta alloys ¹⁷

SOURCE: AN UkrRSR, Dopovidi, no. 4, 1964, 502-505

TOPIC TAGS: martensite, martensitic transformation, titanium, titanium alloy ¹⁶

ABSTRACT: During transformation of the stable high-temperature β -phase of titanium alloys into the stable low-temperature α -phase, three intermediate metastable martensitic phases are formed: 1) a hexagonal α' phase, 2) a rhombic α'' phase, and 3) a hexagonal ω phase. For an investigation of the unclear points regarding the reversibility of the metastable phase transformation $\beta \rightarrow \alpha''$, an $\alpha + \beta$ -titanium alloy was taken containing 1.86% Al and 6.83% Mo. Studies were conducted with forged alloy. The phase composition of the alloy was determined by the powder X-ray diffraction method in a small diameter camera (57.3 mm). During tempering, either metastable phase β or α'' is formed depending on the rate of cooling. In the course of aging of the alloy, the transformation $\beta \rightarrow \alpha''$ is possible. During plastic deformation it is possible to produce a reversible martensitic transformations in titanium alloys ($\beta \rightleftharpoons \omega$ and $\beta \rightleftharpoons \alpha'$) there also exists a $\beta \rightleftharpoons \alpha''$

Card 1/2

L 42285-65

ACCESSION NR: AP4030394

transformation. The ease of $\beta \Rightarrow \alpha$ transformation during plastic deformation of the investigated alloy indicates the closeness of the thermodynamic state functions in metastable transformation. The energy of plastic deformation which is added to one metastable state aids the transition to a more stable state. Orig. art. has: 3 tables.

ASSOCIATION: None

SUBMITTED: 26Mar63

ENCL: 00

SUB CODE: MM

NO REF SOV: 004

OTHER: 001

Card 2/2 CC

L 7030-65 EWT(m)/I/EWP(k)/EWP(q)/EWP(b) Pf-4/Pad ASD(m)-3 MJW/JD/HM/HW

ACCESSION NR: AP4043915

S/0136/64/000/008/0086/0090

AUTHOR: Lashko, N. P.; Lashko, S. V.

TITLE: Diffusion brazing of nonferrous metals and alloys

SOURCE: Tsvetny*ye metally*, no. 8, 1964, 86-90

TOPIC TAGS: brazing, nonferrous metal brazing, nonferrous alloy brazing, diffusion brazing, refractory metal brazing, heat resistant alloy, brazing, activation brazing, high temperature brazing

ABSTRACT: Diffusion brazing differs from other types of capillary brazing by a different mode of solidification. In diffusion brazing, the joint solidifies without cooling at temperatures higher than solidus temperature of the brazing alloy used. Evaporation of some components of the brazing alloy at their diffusion into base metal or the diffusion of some base metal components into the brazing alloy raises the melting point of the resulting alloy above the brazing temperature, which causes the joint solidification. High temperatures of the diffusion brazing accelerate diffusion and greatly reduce the

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L 7030-65

ACCESSION NR: AP4043915

7
magnitude of clamping pressure required. In diffusion brazing with a brazing alloy which forms brittle intermetallic compounds with the base metal, the formation of such compounds can be presented by brazing at temperatures higher than the melting point of the intermetallic compound or compounds in question. For instance nickel can be brazed with copper or nickel-silicon eutectic at 1200C. The resulting joints have a strength higher than that of nickel and a remelting temperature of 1290C. Brazing of the VT1 titanium alloy sheets with nickel (vacuum vapor deposited on the areas to be brazed) at 950C resulted in a formation of a brittle interlayer consisting of the NiTi₂ compound. Diffusion brazing at 1050C produced a complete dissolution of the compound and raised the joint strength to 35 kg/mm² and the joint remelting temperature to over 1290C. Similar results were obtained in diffusion brazing of VT1 sheets with copper when joint strength as high as 50—60 kg/mm² was reached. Diffusion brazing can be activated by using a brazing alloy (in powder form) consisting of powders and a low-melting eutectic of the base metal and some element forming solid solutions with the latter. Orig. art. has: 3 figures and 2 tables.

Cord 2/3

L 7030-65

ACCESSION NR: AP4043915

ASSOCIATION: None

SUBMITTED: 00

ATD PRESS: 3103

ENCL: 00

SUB CODE: MM, IE

NO REF SCV: 005

OTHER: 005

Card 3/3

LASHKO, N.F.; MOROZOVA, G.I.

Crystalline structure of phases rich in magnesium in alloys
of the systems magnesium-cerium and magnesium-neodymium.
Kristallografiia 9 no.2:269-270 Mr-Ap'64. (MIRA 17:5)

L 64385-65 EWT(m)/EWA(d)/EWP(t)/EWP(z)/EWP(b) BJW/JD/MJA(CL)

ACCESSION NR: AR5018956

UR/0276/65/000/007/G007/G007

669.24:620.17:620.183

SOURCE: Ref. zh. Tekhnologiya mashinostroyeniya, Svodnyy tom, Abs. 7G52

AUTHOR: Kurchman, B. S.; Lashko, N. F.; Mikhayeva, V. V.; Bogdanov, A. M.

TITLE: Improving the high-temperature strength of nickel-based cast alloys by composite hardening with carbides, borides, and intermetallic compounds

CITED SOURCE: Tr. Tsentr. n.-i. avtomob. i avtomotorn. in-ta, vyp. 71, 1964, 71-102

TOPIC TAGS: cast nickel alloy, high temperature strength, alloy hardening, carbon admixture effect, composite hardening

TRANSLATION: The authors discuss the mechanism of hardening cast Ni alloys and the effects of various alloying admixtures on mechanical properties and alloy structure. Influence of 0.02 to 0.73% carbon on properties of the Ni alloys was investigated in experiments with alloy ANV-300 (composition in % by weight: 15 - 16 Cr, 7.8 - 9.3 W, 1.5 - 1.8 Ti, 4.7 - 4.9 Al, 0.063 B). Bibl. with 12 titles, 11 tables and 10 illustrations. E. Volin

SUB CODE: MM, MT

ENCL: 00

Card

1/1

L 13553-65

ENT(m)/EPR/ENP(t)/ENP(b) Ps-4

SSD/AFWL/ESD(gs)/ESD(t) JD/JG
S/0032/64/030/010/1187/1189

ACCESSION NR: AP4046464

AUTHOR: Lashko, N. P.; Morozova, G. I.

TITLE: Phase analysis of magnesium alloys containing cerium or neodymium

SOURCE: Zavodskaya laboratoriya, v. 30, no. 10, 1964, 1187-1189

TOPIC TAGS: magnesium cerium alloy, magnesium neodymium alloy, magnesium, cerium, neodymium, alloy phase composition

ABSTRACT: Magnesium-rich phases have been isolated by anodic dissolution from Mg-Ce and Mg-Nd alloys containing 6.1% Ce and 6.2% Nd. X-ray diffraction and chemical analysis of anodic residues showed that phases had a composition of $Mg_{12}Ce$ or $Mg_{12}Nd$. The compounds are isomorphic and have a $Mn_{12}Th$ -type crystal structure. The electrolyte used in this case can also be employed for the extraction of phases from alloys of the Mg-Al-Zn-Mn or Mg-Ce-Mn systems. Orig. art. has: 1 table.

ASSOCIATION: none

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L 13553-65

ACCESSION NR: AP4046464

SUBMITTED: 00

ENCL: 00

SUB CODE: MM

NO REF SOV: 003

OTHER: 001

ATD PRESS: 3130

Card 2/2

I 9679-66 EWT(m)/EWP(v)/T/EWP(t)/EWP(k)/EWP(h)/EWA(c) LJP(c) JD/HM

ACC NR: AP5027600

SOURCE CODE: UR/0135/65/000/011/0018/0020

AUTHOR: Lashko, N. F. (Candidate of technical sciences); Lashko, S. V. (Candidate of technical sciences); Nikitinskiy, A. M. (Engineer)

ORG: none

TITLE: Furnace brazing of aluminum alloys

SOURCE: Svarochnoye proizvodstvo, no. 11, 1965, 18-20

TOPIC TAGS: metal brazing, aluminum alloy, corrosion, zinc chloride, soldering flux, fluoride / F5 soldering flux

ABSTRACT: It is shown that the brazing of aluminum alloys with the aid of zinc chloride-containing flux 34A is inexpedient, since then the surface layers of the aluminum get saturated with the zinc, which leads to chemical corrosion of the brazed metal and a deterioration in its plasticity. Accordingly, the authors investigated the applicability of other flux types to the brazing of AMts, AMl, and AMg aluminum alloys, on proceeding from the premise that $ZnCl_2$ in the soldering fluxes should be replaced with the chlorides (or fluorides) of other metals which activize the flux without causing corrosion of the brazed metals -- aluminum and its alloys. A study of several experimental flux types containing no $ZnCl_2$, and consisting of the chlorides of lithium, potassium, tin, and cadmium, chlorides and sodium fluoride, was carried

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UDC: 621.791.354:669.715

L 9679-66

ACC NR: AP5027600

out: specimens of aluminum and its alloys were separately covered with these fluxes and rapidly heated in a furnace to the test temperatures -- 450, 500, 550, and 600°C, for 10, 20, 30, 40, 50, and 60 min. Subsequent mechanical tests showed that the best results are obtained with flux P5 (NaF 10%, SnCl₂ 3%, LiCl 38%, KCl 45%, CdCl₂ 4%), which prevents the pronounced erosion of the base metal on brazing with aluminum solders. It moreover assures a better joining of metal and improved penetration of solder into the pores and does not reduce the corrosion resistance and mechanical properties of the brazed joints. Further, it is shown that the most probable mechanism of the elimination of Al₂O₃ during the brazing of aluminum and its alloys is dispersion, conditioned by the stripping of the oxide film from the metal surface under the action of the gaseous products of the reaction between aluminum and the chlorides of the metals with a higher vapor pressure (AlCl₃, AlCl), as well as by the wetting of the oxide particles by the chlorides and fluorides of metals. Orig. art. has: 6 figures, 2 tables.

SUB CODE: 11, 13/ SUBM DATE: none/ ORIG REF: 002/ OTH REF: 002

CC
Card 2/2

L 45448-65 EWT(m)/EWP(w)/EWA(a)/EWP(z)/EWP(z)/EWP(b)/EWA(c) MJW/JD/GS
 ACCESSION NR: AT5011338 UR/0000/65/000/000/0039/0047 32
 B+1

AUTHOR: Blok, N. I.; Lashko, N. F.; Morozova, G. I.; Radetskaya, E. M.

TITLE: Surface oxidation and phase changes in heat-resistant nickel alloys in the stressed state 16 27

SOURCE: Fazovyy sostav, struktura i svoystva legirovannykh staley i splavov (Phase composition, structure, and properties of alloy steels and alloys). Moscow, Izd-vo Mashinostroyeniye, 1965, 39-47

TOPIC TAGS: nickel alloy, heat resistant alloy, alloy phase transition, alloy oxidation, surface oxidation, alloy structure, alloy fatigue, metal diffusion, alloy aging, carbide formation 16 16

ABSTRACT: The aim of this work was to study the influence of stress on structural changes related to diffusion processes in the surface and inner layers of heat-resistant nickel alloys EI437B, EI617, and EI929. The specimens were fatigue-tested, and their anodic deposits were analyzed chemically. In alloy EI437B, the following phases were observed by x-ray analysis: intermetallic σ' phase $\text{Ni}_3(\text{Al}, \text{Ti})$, containing a small amount of chromium; chromium carbides Cr_7C_3 and Cr_{23}C_6 ; titanium carbonitride $\text{Ti}(\text{C}, \text{N})$. Aging of EI437B at 800C is associated

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ACCESSION NR: AT5011338

with the phenomenon of recovery. Alternate loading of alloy EI617 at 800-1018C has no appreciable effect on the oxidation rate or on the migration of the alloying elements away from the surface layers as compared to the action of heat alone. The effect of stress on EI617 is manifested to a lesser extent than in the case of EI437B. Aging of EI617 at 900C is accompanied by its softening, which is extensive both during fatigue testing and during heating without a load. In the high alloy EI929, the application of loads at 900C has almost no effect on the phase composition. Orig. art. has: 5 figures and 1 table.

ASSOCIATION: none

SUBMITTED: 17Dec64

ENCL: 00

SUB CODE: MM, SS

NO REF SOV: 004

OTHER: 002

Card 2/2

L 52058-65 EPA(m)-2/EWT(m)/EWP(w)/EPP(n)-2/EWA(d)/T/EWP(t)/EWP(z)/EWP(b)/
EWA(c) Pad/Pt-7/Pu-4 IJP(c) JD/WW/HW/JG/GS
ACCESSION NR: AT5011339 UR/0000/65/000/000/0048/0054

AUTHOR: Blok, N. I.; Lashko, N. F.; Sokolova, N. G.; Khremova, O. A.

TITLE: Phase composition and high-temperature strength of nickel-beryllium
alloys containing tungsten and molybdenum

SOURCE: Fazovyy sostav, struktura i svoystva legirovannykh staley i splyavov
(Phase composition, structure, and properties of alloy steels and alloys).
Moscow, Izd-vo Mashinostroyeniye, 1965, 48-54

TOPIC TAGS: alloy phase composition, alloy heat resistance, refractory alloy,
nickel alloy, beryllium alloy, tungsten containing alloy, molybdenum containing
alloy, overaging zone

ABSTRACT: To elucidate the characteristics of molybdenum and tungsten as alloying
elements in nickel-beryllium alloys, three melts were studied having the following
compositions: (1) 1.93% Be, bal. Ni; (2) 2.65% Be, 1.18% W, bal. Ni; (3) 2.20%
Be, 5.0% Mo, bal. Ni. Forged bars quenched from 1080C and aged for 5 hrs. at
520C were tested. The phase composition of anodic deposits was determined. The
results of phase and microstructural analyses of these alloys show that one of
the causes of the greater high-temperature strength of the alloy containing moly-
bdenum is the retardation and depression of the discontinuous decomposition

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ACCESSION NR: AT5011339

2

observed in the alloy containing tungsten. The discontinuous decomposition is characterized by a rapid precipitation of particles of the NiBe phase in the depleted solid solution in the so-called zones of overaging. The formation of these zones in separate boundary regions in the alloy containing tungsten leads to a faster softening at high temperatures and to a marked decrease in heat resistance. Orig. art. has: 4 figures and 3 tables.

ASSOCIATION: none

SUBMITTED: 17Dec64

ENCL: 00

SUB CODE: MM

NO REF SOV: 003

OTHER: 000

Card 2/2

45450-65 EMT(m)/EMP(w)/EWA(a)/E/EWP(t)/EWP(z)/EWP(b)/EWA(n) IJP(c)
 ACCESSION NR: AT3011341 MJW/JD/GS IR/0000/65/000/000/0063/0068 26
 24
 B+1
 AUTHOR: Lashko, N. F.; Rodina, Ye. Ya.
 TITLE: Effect of iron on the phase composition, structure, and properties of casting alloys of the type ZhS
 SOURCE: Fazovyy sostav, struktura i svoystva legirovannykh staley i splavov (Phase composition, structure, and properties of alloy steels and alloys). Moscow, Izd-vo Mashinostroyeniya, 1965, 63-68
 TOPIC TAGS: casting alloy, alloy phase composition, alloy structure, alloy strength, iron admixture, carbide formation / ZhS alloy
 ABSTRACT: Casting alloys ZhS6 and ZhS3-D, containing different amounts of iron, were heated for 4 hrs. at 1200C and cooled in air, then subjected to short-term tensile tests and stress-rupture tests. The characteristics obtained in short-term tests of ZhS6-type alloys decline markedly as the iron content increases above 1.75%. Iron in amounts above 3% in ZhS3-D and above 5% in ZhS6 sharply reduces the resistance of the specimens in tests for stress-rupture strength. Such behavior is explained by a change in the state of the solid solution (decrease in strength and thermal stability), phase composition, and structure.
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ACCESSION NR: AT5011341

Iron in the alloys decreases the solubility of ²⁷tungsten and ²⁷molybdenum, increases the dispersity of the α' phase, changes its composition, and decreases its amount. A rise in the iron content of the alloy promotes the precipitation of binary carbides in the form of coarsely dispersed particles. When the iron content increases above 13%, coarse particles of the intermetallic phase $Fe_7(Mo, W)_6$ precipitate; this combined with other factors causes a decrease in static crack strength and stress-rupture strength. Orig. art. has: 2 figures and 5 tables. ²

ASSOCIATION: none

SUBMITTED: 17Dec54

ENCL: 00

SUB CODE: MM, SS

NO REF SOV: 002

OTHER: 000

me
Card 2/2

L 45451-65 EWT(m)/EWP(w)/EWA(d)/T/EWP(t)/EWP(z)/EWP(b)/EWA(c) Pad IJP(c)
 ACCESSION NR: AT5011342 UR/0000/65/000/000/0069/0079 HJW/JD/
 HW/GS

AUTHOR: Gusev, Ye. V.; Lashko, N. F.

TITLE: Study of structural transformations in nickel alloys and steels by the electrical resistance method

SOURCE: Fazovyy sostav, struktura i svoystva legirovannykh staley i splavov (Phase composition, structure, and properties of alloy steels and alloys). Moscow, Izd-vo Mashinostroyeniye, 1965, 69-79

TOPIC TAGS: alloy structure, nickel alloy, refractory alloy, heat resistant steel, alloy conductivity, steel electrical property, alloy hardness, austenitization

ABSTRACT: The heat-resistant nickel alloy EI437B, heat-resistant steel EI696, and steel SN 3 were investigated. The electrical resistance was measured every 20-50C at 10^{-4} mm Hg with a potentiometric device during heating and cooling in the range of 0 to 1000C. Hardness was also measured. In the case of EI437B, during heating from 20 to 1000C, the data showed the presence of complex, undifferentiated processes of formation of the k-state (inhomogeneity of the solid solution), followed by precipitation of the phase $Ni_3(Al, Ti)$, and its

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ACCESSION NR: AT5011342

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dissolution. In the case of EI696, the phase β -Ni₃Ti precipitates, particularly at 750-775C; holding at 800C causes the phase to dissolve. A considerable hardening of EI696 is observed in the course of aging beginning at 600C. The formation of the k-state was not detected in SN3. An inflection on the electrical resistance-temperature curve of the aged alloy following normalization and deep cooling is probably due to the process of austenitization. Orig. art. has: 5 figures.

ASSOCIATION: none

SUBMITTED: 17Dec64 -----

ENCL: 00

SUB CODE: MM, SS

NO REF SOV: 002

OTHER: 003

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